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# Thermal modelling of magmatic geothermal systems: the role of deep-seated heat sources

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High-temperature geothermal fields are mostly associated with the occurrence of intrusive and/or extrusive magmatic centers. We present the results achieved in different National and European research projects, i.e. Geothermal Atlas of Southern Italy, Descramble and Gemex projects. We applied an integrated approach in order to set-up numerical models able to simulate the conductive-convective thermal structure of selected high-temperature geothermal fields, i.e. the southern sector of Larderello area (Central Italy), the Ischia Island (Southern Italy), the Acoculco caldera complex (Mexico) and the Long Valley caldera (US). In the above-mentioned geothermal fields, both the high geothermal gradients measured in the impervious rocks and the thermal effects of the circulating hot fluids in the deep-seated reservoirs suggest the occurrence of young and shallow magma bodies acting as the main heat source of the overlying hydrothermal systems. In this context, the age of the last magmatic event, the emplacement depth and temperature are key aspects in understanding the geothermal system and assessing its potential. How long magma bodies persist in the mid- to upper crust is a fundamental information to understanding also the relationship of magmatism to geothermal resources in continental settings. We propose a numerical approach implemented in a Finite Element (FE) environment capable to evaluate the contribution of the main variables that characterize the heat source and the reservoir. The final 3D thermal models were achieved via the optimization of the available temperature measurements in deep boreholes tacking into account the thermal effects of the interplay between the free convection and the topographically driven groundwater flow, the reservoir permeability and the thermal load released by the parametrized heat source.

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